The Midlatitude Response to Fluctuating Tropical Heat Sources

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NCAR
total OLR daily variance during DJFM
Lessons from the constant forcing case

① Planetary wave dispersion

- Garcia & Salby (1987)
- Li & Nathan (1994)
- Yang & Hoskins (1996)
Lessons from the constant forcing case

① Planetary wave dispersion
② Dynamical feedbacks & scale interactions
③ Additional factors: baroclinity, irrotational component, moisture, …
OLR at (90E,0N)
(20x8 degree box)

1 Dec 85-30 Mar 86

OLR anomalies from seasonal mean

1 Dec 76-30 Mar 77

OLR anomalies from seasonal mean

(C/day max equivalent)
Basic building blocks:
Response to a pulse
CAM3 <v300> response to 2-day heat pulses
(2000 member ensembles; difference positive and negative)
Constructing a Green’s function

\[ G(\lambda, \varphi, \lambda_h, \varphi_h, t - \tau) \]
Decomposition of response to idealized MJO

CAM3 v300 response to +4deg/d heating at 135E

contour=0.5m/s

contour=0.05m/s

-10days

-6days

-3days
CAM3 <v300> response to 2-day heat pulses
(2000 member ensembles; difference positive and negative)
translation mean $<v_{300}>^2$

5°C/day 2-day pulse

day 2

1.7^2 \text{ m}^2\text{s}^{-2}

day 5

0.7^2 \text{ m}^2\text{s}^{-2}
translation mean $<v_{300}>^2$

5C/day 2-day pulse

zonal average

30N-60N average
CAM3 response to a pulse

$\langle v_{300} \rangle$

(0.08 m/s contour)
versus 2 days earlier

Structure of \(<v300>\) response to 2-day pulse

poleward of 30°
Normalized spectra for pulse heating and response

psi300 response

heating
CAM3 response to a pulse

<\textit{v300}>

(0.08 m/s contour)
Structure of $\langle v300 \rangle$ response to 2-day pulse

- versus 2 days earlier
- versus steady response
translation mean $\langle \text{var}(\psi_{300\text{bp}}) \rangle^2$

5C/day 2-day pulse
Remember

- Even **short-lived** tropical heating events can affect remote midlatitude locations
- The reaction is **delayed, long-lived, and persistent**
- Many midlatitude fields are affected, including the synoptic eddies
- Hence short-lived tropical heating may produce **predictability of the second kind** for a couple of weeks